US Army Medical Research and Materiel Command

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Compositions and Methods for Reducing Blood and Fluid Loss from Open Wounds

This invention provides gel-forming compositions and methods for their use in reducing blood and fluid loss from open wounds, denuded tissue, or burned skin. The ionizable groups in an anhydrous polymer or composition react with the water in the blood or body fluid to form a hydrogel. The hydrogel has sufficient cohesiveness and adhesiveness to cover emerging blood or other body fluids and adhere to the damaged tissue.

Heavy bleeding is usually controlled through external pressure applied to adjacent tissue or by bandaging. The blood typically adheres to damaged tissue, forms clots, and then slowly transforms into a scab that acts as a skin substitute. Compositions that quickly form artificial scabs are needed.

The compositions are comprised of anhydrous polymers such as polyacrylic acids that are covalently crosslinked to form unique macromolecules known as carbomers. Hydrated polyacrylic chains of these macromolecules present superficial carboxyl groups for strong bioadhesion to wet tissues. The macromolecules absorb water rapidly enough to concentrate blood clotting factors but slowly enough to remain bioadhesive until clotting is complete. They are used alone or mixed with additives, ground into a finely divided form, and placed directly onto wounds. Water from blood or serum rapidly initiates formation of an artificial blood clot over an induced natural clot; drying produces an artificial scab over a superficial wound. The carbomers can be combined with a variety of alkaline or non-alkaline additives, antibiotics, and other substances. Once cured, the compositions are resistant to wiping with water, but can be removed with physiological saline solution or solutions containing calcium or magnesium ions. One composition protected rabbit wounds against nerve, blistering, or tear gas agents, facilitated skin healing, and minimized scarring. Another composition arrested liver hemorrhage, in rabbits. In 3 of 4 pigs tested, 100% carbomer and gauze stopped arterial bleeding immediately; reapplication was effective in the fourth pig.

Features and advantages:

- Immediately initiates hemostasis and avoids delay of fibrin-based clotting
- Arrested liver hemorrhage and facilitated skin healing in rabbits
- Prevented lethal arterial bleeding in pigs by forming a gummy artificial clot where a tourniquet could not be used
- Water from wound quickly changes free-flowing, low-cost powder into a bioadhesive wound sealant that does not wash away
- Initiates natural clotting; could stop bleeding from hemophilia or "blood thinners"; left to dry, it becomes an artificial scab

Patent Status

Publication No.: 20030008011
Date Published: January 9, 2003
Available from: www.uspto.gov
Docket No.: RICD 00-07

Point of Contact

Dr. Paul C. Mele
Director, Office of Research and Technology Applications
USAMRMC, MCMR-ZA-J
504 Scott St., Ft. Detrick, MD 21702-5012
E-mail: usamrmcorta@amedd.army.mil
Voice: 301-619-6664/2065/7219 Fax: 301-619-5034
KEYWORDS: arterial homeostasis; artificial scab; macromolecular polymer; carbomer; bioadhesive; clotting inducer; wound sealant

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